



National Oceanic and Atmospheric Administration | NOAA Satellite and Information Service

HURRICANES

Information & Activity Booklet
Ages 9 & Up!



On August 26, 2011, **HURRICANE IRENE** was a powerful Category 2 hurricane. This image shows the storm as it moved northward along the U.S. eastern coastline with 110 mph sustained winds.

A satellite image of a hurricane, showing a large, swirling cloud system over the ocean. The image is the background of the entire page.

HURRICANES

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NOAA Satellites: Watching Our Seas and Skies

Satellites are the electronic eyes that have taken NOAA from beyond Earth's orbits to deep within the oceans. Geostationary and polar environmental satellites help meteorologists identify and track doughnut shaped storm systems known as hurricanes.

POES

GOES

Geostationary Operational Environmental Satellites (GOES)

support short-range weather forecasts and warnings. They are positioned over the Equator at approximately 22,300 miles above the Earth. The images are used to monitor severe weather conditions (e.g., tornadoes, hurricanes, rainfall).



Polar-orbiting Operational Environmental Satellites (POES)

support global long-range forecasting (e.g., drought, climate, wildfires). They are positioned in North - South orbits at 500 miles above Earth; taking images of the entire planet every six hours.

GOES

POES

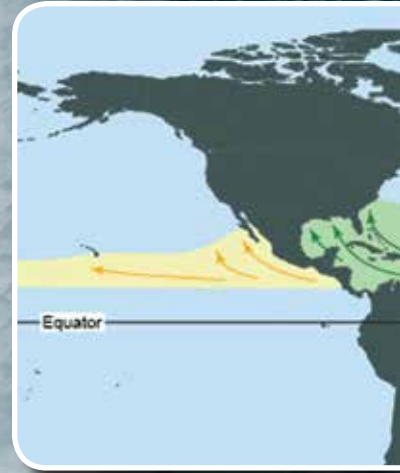
Tropical Cyclones: Hurricanes and Typhoons

Did you know that “**hurricanes**” and “**typhoons**” are location specific names for “**tropical cyclones**”? Tropical cyclones are rotating, organized systems of clouds and thunderstorms that occur near the equator in warm or tropical waters, which help fuel the storm.

The strong winds associated with the storm are continuously rotating in a counterclockwise pattern in the Northern Hemisphere and a clockwise pattern in the Southern Hemisphere. The winds help produce a well-defined center, known as the “**eye**.” The eye is the calmest part of the storm, with light winds and clear skies.

Hurricanes can produce other hazardous weather events during its life span, such as: **floods, tornadoes, damaging winds, rip currents and heavy rainfall**.

Hurricanes or tropical cyclones occur in the North Atlantic Ocean, Northeast Pacific Ocean or the South Pacific Ocean, and are classified as such when winds reach 74 miles per hour (mph) and above. The Atlantic hurricane season runs from June to November. There are five categories of a hurricane (see page 7). Typhoons occur in the Northwest Pacific Ocean and are classified when winds reach 74 mph or higher. There is no official hurricane season, but most occur between July and November. Cyclones occur in the Southwest Indian Ocean and are classified when winds reach 74 mph. Most cyclones usually occur between October and May.

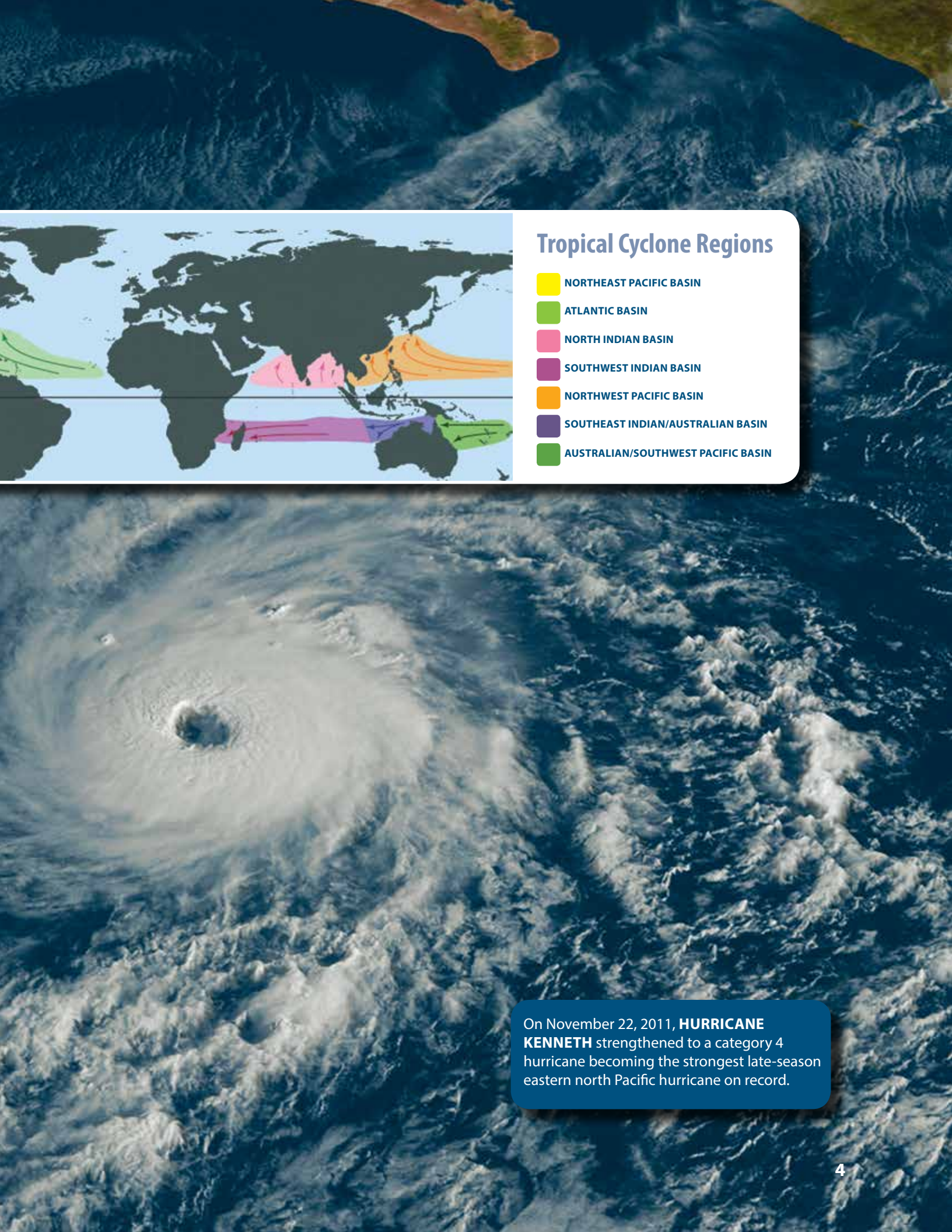


Hurricane Names

“Hurricane” comes from the Mayan word “Hurakan,” who was a god of wind. When angry, Hurakan blew his breath across the water and dry land. Ivan R. Tannehill wrote a book entitled “Hurricanes” that explained hurricanes were named after saints. Before the end of the 19th century, Australian meteorologists began naming storms after women. In 1953, the United States began using a phonetic alphabet (Annyepearl, Barbara, Cheryl...) process. In 1978, men’s names were added.

A series of names are needed because two or more storms can occur at the same time. The names vary because hurricanes are tracked by the weather services of many countries. Names are discussed and agreed upon at World Meteorological Organizational meetings. In the Atlantic basin, tropical cyclones names are “retired” if it is deemed to be quite noteworthy because of the damage and/or deaths it caused. This is to prevent confusing a historically well-known cyclone with a current one in the Atlantic basin. To learn more about how storms are named, go to:

www.nhc.noaa.gov/aboutnames.html



Tropical Cyclone Regions

-  NORTHEAST PACIFIC BASIN
-  ATLANTIC BASIN
-  NORTH INDIAN BASIN
-  SOUTHWEST INDIAN BASIN
-  NORTHWEST PACIFIC BASIN
-  SOUTHEAST INDIAN/AUSTRALIAN BASIN
-  AUSTRALIAN/SOUTHWEST PACIFIC BASIN

On November 22, 2011, **HURRICANE KENNETH** strengthened to a category 4 hurricane becoming the strongest late-season eastern north Pacific hurricane on record.

How Hurricanes Form

Did you know that tropical cyclones form from the left to right?

These large storms begin as a small area of thunderstorms and grow into a larger storm made up of high winds and severe thunderstorms. To see how a hurricane forms, look at the graphic below following from number 1 to 4.

4



Hurricane

A tropical cyclone with winds at 74 mph and thunderstorms

3



Tropical Storm

A tropical cyclone with maximum winds of 39-73 mph, and thunderstorms

On October 17, 2009, **HURRICANE RICK** was a Category 5, with maximum sustained winds of 180 mph. These winds made Rick the second most powerful hurricane on record in the Eastern Pacific, behind Hurricane Linda in 1997.

1



Tropical Disturbance

An area of thunderstorms, heavy rains and gusty winds

2



Tropical Depression

An organized area of tropical low pressure where winds are 38 mph or less

The Saffir-Simpson Hurricane Wind Scale

This scale rates the strength of a storm. The hurricane is given a category number from one through five based on the wind speed.


Category One Hurricane: 74-95 miles per hour (mph), 64-82 knots (kt), or 119-153 kilometer per hour (km/hr) and storm surge 4-5 feet (ft). Very dangerous winds will produce some damage.

Category Two Hurricane: 96-110 mph, 83-95 kt, or 154-177 km/hr and storm surge 6-8 ft. Moderate dangerous winds will cause extensive damage. There is a large risk of injury or death.

Category Three Hurricane: Sustained winds 111-129 mph, 96-112 kt, or 178-208 km/hr and storm surge 9-12 ft. Extensive damage will occur. There is a high risk of injury or death.

Category Four Hurricane: 130-156 mph, 113-136 kt, or 209-251 km/hr and storm surge 13-18 ft. Extreme damage will occur. There is a very high risk of injury or death.

Category Five Hurricane: Sustained winds greater than 155 mph, greater than 137 kt, or greater than 249 km/hr and storm surge more than 19 ft. Catastrophic damage will occur. High risk of injury or death is certain from flying or falling debris, even if indoors in mobile homes or framed homes.

A satellite image of Hurricane Katrina, showing a well-defined eye and spiral cloud bands, positioned over the Gulf of Mexico. The surrounding landmasses, including the southern United States and Central America, are visible in green and brown tones against the blue ocean.

Visit the **NOAA ENVIRONMENTAL VISUALIZATION LABORATORY** web site to view images and animations of hurricanes and other data visualizations.

www.nnvl.noaa.gov

On August 28, 2005, **HURRICANE KATRINA** was a Category five hurricane as it headed towards the Louisiana coast.

Preparing for a Hurricane

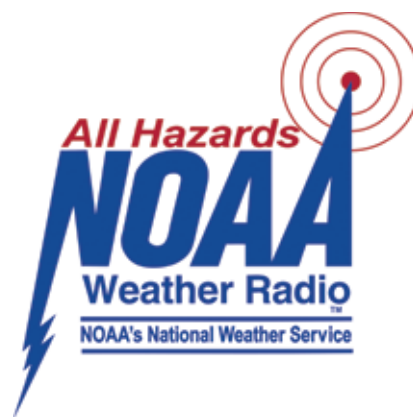
Watches and Warnings

The National Hurricane Center will issue a watch. The watch tells people who live or work near the coast, usually within 36 hours, when the hurricane over the ocean will reach land.

NOAA's National Weather Service (NWS) will issue a warning, usually within 24 hours. When a NWS warning is issued, the winds are expected to affect land. These strong winds will cause trees to fall, creating power outages. Also, loose objects like trash cans and bikes could fly and hit you, your car or your house. If you are in a boat fishing or sailing, the water could become rough and your boat could flip. You could drown or your boat could go far out to sea.

What Should I Do? Where Should I Go?

If you do not live on the coast or shore or you can not leave your home, listen to a NOAA Weather Radio or TV for information. Secure your home. Put boards over windows, close all interior doors, keep the curtains and blinds closed and stay indoors. Go to a small interior room, closet or hallway on the lowest level. Turn your refrigerator thermostat to the coldest temperature and keep the door closed. Fill your bathtub or a large container with water to make sure you have water for cleaning and flushing the toilet. Don't forget to bring your pet, toys and outside plants indoors. Wind is very strong. Wind over 100 miles per hour will cause trees, electricity poles and some houses to fall. Window panes can be blown out and flooding can occur.



The NOAA Weather Radio is a nationwide network of radio stations broadcasting continuous weather information directly from the nearest National Weather Service office. NOAA Weather Radio broadcasts official Weather Service warnings, watches, forecasts and other hazard information 24 hours a day, 7 days a week.

www.weather.gov/nwr

When Should I Evacuate?

If you live in any of the conditions below, when a hurricane is approaching you should consider evacuating your location for some place inland, away from the coast:

- 1) Near the coast, on a flood plain or near a river
- 2) A mobile home or temporary structure
- 3) A high-rise building

Evacuate when the local authorities say so. Discuss an emergency plan with your family that entails a special meeting place, emergency numbers to call and other safety measures such as making a first aid kit. For more about hurricane preparedness, visit the following link:

www.nhc.noaa.gov/HAW2/english/prepare/place_to_go.shtml

Are You Prepared?

Here are some items you should have available for an emergency:

- Prescription medications and medical supplies
- Bedding (sleeping bags, pillows) and clothing
- Three-Day supply of bottled water
- Non-perishable food, manual can opener
- Battery-operated radio, extra batteries
- First aid kit, flashlight, candles, and matches
- Copies of documents (driver's license, social security card, proof of residence, birth certificate)
- Car keys and map
- Cash and credit cards



Hurricane Hunters: Storm Explorers

Since 1944, these aircraft have flown through and around tropical storms and hurricanes to collect environmental and geographic data. The data and measurements help scientists conduct research and assist meteorologists in making forecasts.



NOAA hurricane hunter WP-3D Orion and Gulfstream IV aircraft in flight.



A view of the **Hurricane Katrina** eyewall taken from inside the eye.

Word Search

Find the words listed on the right. The answers will be listed diagonally, backwards, forwards, horizontally, or vertically.

S G W N C D V G H Z M H G A R
W A I E Y M E G U J G L I P O
W A T O R O C H R F A C T C A
K I L E R D Z U R L I N D A T
B F L G L C N V I A N F D E U
G S E M U L J A C N Y B K T V
L S U G A R I U A I L I W R N
D D I D T J X T N B I I P O X
H U N T E R S B E E M P P P B
F B S K P W K Z S S E F I I W
M E T E O R O L O G I S T C D
A N I R T A K Z Y Y U T X A A
A C O K A Z Y J D T M O A L B
O Y C Y C L O N E Z M R D G K
N Y G N I N R A W Q I M Z I B

**WILMA
SATELLITES
METEOROLOGIST
LINDA
KATRINA
HURRICANES
GEORGES
FLOYD
EMILY
CYCLONE
ANDREW
TROPICAL
WARNING
NOAA
STORM
HUNTERS**

The Eye of the Hurricane

The "eye" is a circular area in the center of a hurricane, consisting of light winds and fair weather. There is little or no precipitation and sometimes clear skies can be seen. The eyes vary in size and can be between 5 - 120 miles across.

The eye is surrounded by the "eyewall," a circular ring of deep convection that is the area of highest surface winds in the tropical cyclone.

For more information, visit:

www.aoml.noaa.gov/hrd/tcfaq/A11.html

Preparing for a Hurricane

List five things you can do to prepare for a hurricane.

1. _____
2. _____
3. _____
4. _____
5. _____

Guess the Words

Use NOAA satellite facts mentioned in this book to figure out the answers below.

1. Name the two types of NOAA satellites:

2. Satellites help us watch and study our _____ and _____

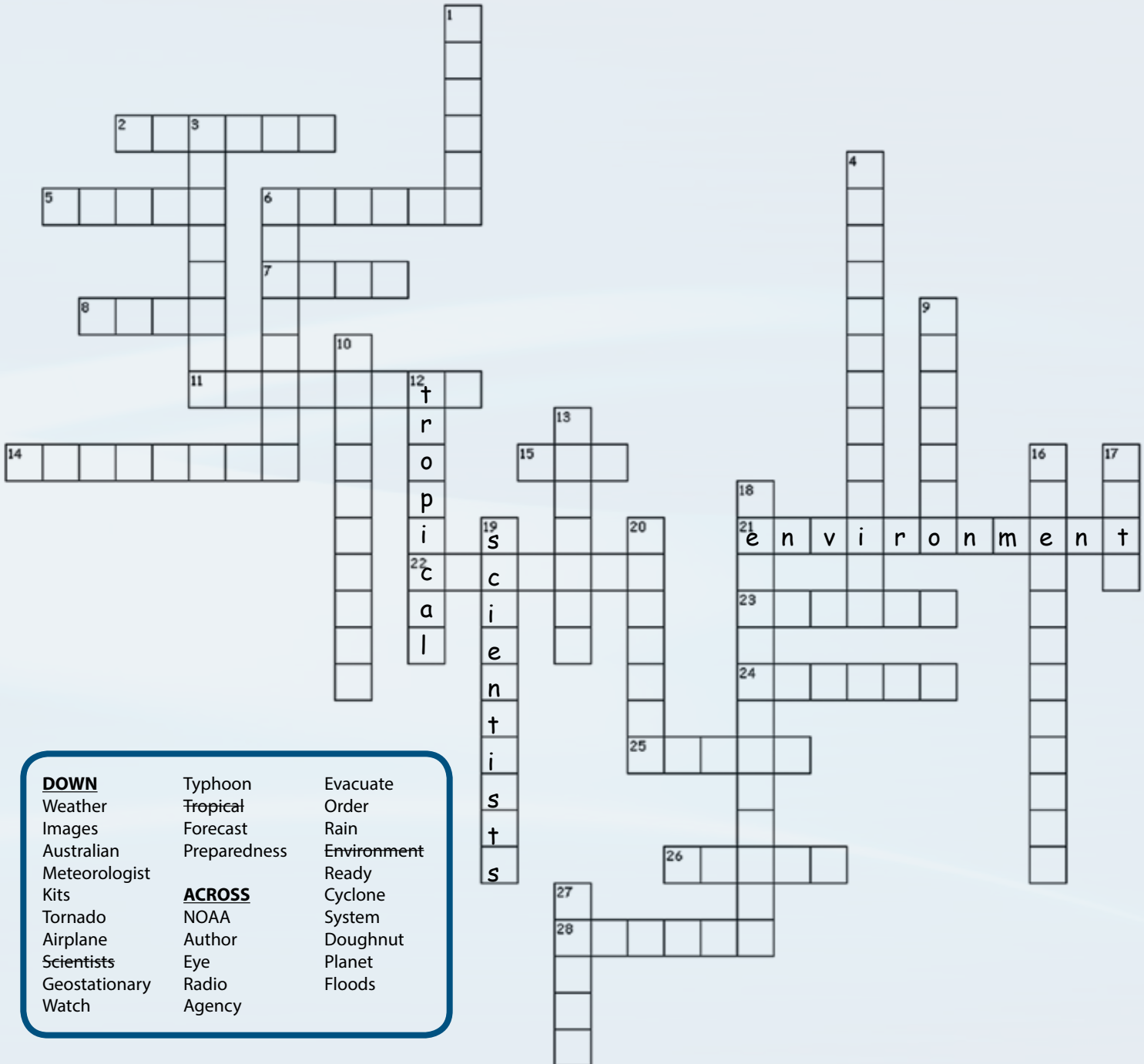
3. _____ is positioned approximately 22,300 miles above Earth

4. _____ takes images of the entire planet every six hours

5. _____ are the electronic eyes that take pictures of the Earth

Crossword Puzzle

Find the words listed below. A few of the words have been found for you.



DOWN

Weather
Images
Australian
Meteorologist
Kits
Tornado
Airplane
Scientists
Geostationary
Watch

Typhoon
Forecast
Preparedness

ACROSS

NOAA
Author
Eye
Radio
Agency

Evacuate
Order
Rain
Environment
Ready
Cyclone
System
Doughnut
Planet
Floods

Word Cyclone

A tornado has scrambled the words! Try to unscramble the words and place them on the blank lines below.

cuevaate

roaytecg

enacrihur

enadotors

licatorpi

oitsumre

ewatehr

ealtitsel

ycenscol

fallnair

Hidden Cyclones

How many times can you find the word “cyclone”? The words will be listed horizontally or vertically.

c	y	c	l	o	n	e	o	n	e	n	e	y	c	y	c	l	o	n	e
o	c	o	y	c	e	o	n	c	y	c	l	o	n	e	y	o	n	e	y
n	o	l	c	n	y	n	c	y	c	l	o	n	e	y	c	n	y	o	c
c	y	c	l	o	n	e	o	c	l	y	c	e	l	c	l	e	c	l	c
e	c	y	c	l	o	n	e	l	e	n	y	l	o	l	o	y	o	e	y
y	o	c	o	n	e	l	y	o	n	c	y	c	o	o	n	e	y	o	c
e	n	l	c	y	n	o	l	n	c	y	c	l	o	n	e	c	n	c	l
o	l	o	y	c	y	c	l	e	l	c	o	n	l	e	l	o	l	y	o
n	c	n	c	y	c	l	o	n	e	o	c	y	c	l	o	n	e	l	n
e	y	e	y	c	y	o	n	o	c	y	c	l	o	n	e	c	y	c	e

Hurricanes and Tornadoes

Tornadoes are funnel shaped, occur over land, tend to last for a period of minutes and can occur within the high winds of a hurricane. Tropical cyclones, also known as hurricanes, are shaped like a doughnut and occur over the ocean.

Hurricanes tend to last for several days, dissipating over land due to the lack of their source of energy—warm ocean water.

For more information, visit:

www.aoml.noaa.gov/hrd/tcfaq/L1.html

Hurricane Knowledge

This book is filled with information about hurricanes. Use this book as a resource and fill in the blanks using the following words.

Watch

Eye

Radio

Flooding

Season

Days

Warning

Inland

Form

Hunters

1. Hurricanes can last for several _____ before breaking up over land.
2. Hurricane _____ fly through and around hurricanes to collect data.
3. Tropical cyclones _____ form from left to right.
4. The Atlantic hurricane _____ lasts from June to November.
5. Hurricanes can cause _____ among many other issues.
6. A hurricane _____ tells people a hurricane may reach land within 2 days.
7. A hurricane _____ means a hurricane is expected within 24 hours.
8. NOAA Weather _____ warns people about hurricanes.
9. During a hurricane, if you live near the ocean, go _____ where it is safe.
10. The center of a hurricane is called the _____.

Weather and Warnings

Circle "T" (true) or "F" (false) for each statement below.

- | | | |
|---|---|---|
| T | F | 1. Hurricanes and tornadoes are the same type of storm. |
| T | F | 2. Hurricanes are very large storm systems. |
| T | F | 3. High winds are the main cause of loss of life in a hurricane. |
| T | F | 4. When a hurricane is coming, you should not evacuate when authorities say so. |
| T | F | 5. Hurricane Hunters are able to fly through and around hurricanes to collect data. |
| T | F | 6. There are 10 categories of a hurricane. |
| T | F | 7. Hurricane is another name for tropical cyclone. |
| T | F | 8. The eye of the hurricane is the calmest part of the storm. |
| T | F | 9. NOAA satellites are able to take pictures of hurricanes. |
| T | F | 10. During a tropical storm, get under a tree for protection. |

HURRICANE KATIA on September 6, 2011.

Hurricanes and More

How many words can you make from the letters in H_U_R_R_I_C_A_N_E_S? Use each letter once, and try to make 3-, 4-, 5-, or 7- letter words.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

HURRICANE DORA neared Category Five strength, as it moved over the eastern Pacific Ocean on July 21, 2011.

Hurricane Events

Use the Internet or other resources to research the hurricane names below. Put the letter on the line that identifies the correct hurricane name. Once complete, unscramble the words to find the answer to the question at the bottom of the page.

Andrew = I

Emily = C

Floyd = R

Fran = T

Linda = O

Katrina = L

Wilma = A

Georges = P

- _____ Storm occurred on September 18, 1998.
- _____ On August 31, 1993, this polar imagery captured a hurricane moving north along the Atlantic coast just east of Cape Hatteras, North Carolina.
- _____ On August 23, 1992, traces the track of the storm as it swept from the Atlantic Ocean through Florida, across the Gulf of Mexico and into Louisiana.
- _____ On September 12, 1997, this storm approached Baja, California.
- _____ On October 19, 2005, this 21st named storm of the season and 12th hurricane became the most intense hurricane recorded in the Atlantic Basin.
- _____ On September 5, 1996, this storm shows the eye making landfall near Cape Fear, North Carolina.
- _____ On September 14, 1999, this storm roared through the Bahamas with 150 miles per hour winds.
- _____ On August 29, 2005, this Category 4 storm made landfall near the southern Louisiana Coast with 140 miles per hour winds.

What type of waters do hurricanes form in?

_____r_____

Vocabulary

Atmosphere	The air, or layer of gases, surrounding the Earth.
Clement Wragge	An Australian meteorologist who began naming Hurricanes.
Clouds	Visible water drops in the sky.
Flood	A lot of water overflowing dry land.
Forecast	A prediction of a weather condition.
Front	A boundary between two air masses of different temperature.
GOES	Geostationary Operational Environmental Satellites: used for short-range warning.
Hail	The frozen drops of water that fall from the sky.
Hunters	The name of the airplane that flies through the storms.
Hurricane	An intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 miles per hour (64 knots) or higher.
Ivan R. Tannehill	Author of the book, "Hurricanes."
Lightning	An intense electrical discharge that produces a flash of light from a cloud.
Meteorologist	A scientist trained in weather and climate conditions.
NOAA	National Oceanic and Atmospheric Administration: a scientific agency that provides information and data about life on Earth, our oceans, atmosphere and living marine resources.
Phonetic Alphabet	A listing order in which named storms are listed.
POES	Polar-orbiting Operational Environmental Satellites: used for global long-range forecasting.
Precipitation	The falling of rain, mist, hail, sleet or snow on the Earth.

Radar	An instrument used to track storms.
Rainfall	Small drops of water falling from the sky.
Rain	Shower large amounts of rain falling from the sky.
Rip Current	Channeled currents of water flowing away from shore.
Saffir-Simpson Scale	Rate of intensity of a storm.
Satellites	Machines that orbit the Earth with electronic eyes.
Short-Term Watches	These warnings provide detailed information about specific hurricane threats, and Warnings such as flash floods and tornadoes.
Storm Tide	A combination of storm surge and the normal tide (i.e., a 15-foot storm surge combined with a 2-foot normal high tide over the mean sea level created a 17 foot storm tide).
Storm Surge	An abnormal rise of water generated by a storm's winds.
Tornado	A strong rotating column of air in contact with the ground.
Tropical Depression	An organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of 38 MPH (33 knots) or less.
Sustained Winds	One-minute average wind measured at about 33 feet (10 meters) above the surface.
Tropical Storm	An organized system of strong thunderstorms with a defined surface circulation and maximum sustained winds of 39–73 MPH (34–63 knots).
Watches	Hurricane/tropical storm conditions are possible in the specified area, usually within 36 hours. Tune in to NOAA Weather Radio, commercial radio or television for information.
Warning	Hurricane/tropical storm conditions are expected in the specified area, usually within 24 hours.
Winds	The flow of air on a large scale.

NOAA Resources

NOAA

www.noaa.gov

Find out everything you need to know about NOAA.

NOAA Education

www.education.noaa.gov

This site provides students, teachers, librarians and the public access to educational activities, publications and booklets.

NOAA Education and Training

www.epp.noaa.gov

This site provides information on various educational opportunities through the Educational Partnership Program at NOAA.

NOAA Satellite and Information Service

www.nesdis.noaa.gov/EducationOutreach.html

This site provides educational material and resources related to satellite, weather and climate.

NOAA Library

www.lib.noaa.gov

The library provides scientific, technical and legislative information to users such as NOAA staff, general public, academia, industry and other government agencies.

NOAA Education Outreach Center

A limited supply of free printed educational materials are available for distribution. Requests for educational materials should be addressed to:

NOAA Outreach Program Specialist

NOAA Office of Education

1305 East West Highway, SSMC4, Room 1W514

Silver Spring, MD 20910

Phone: (301) 713-1208

E-mail: NOAA-OUTREACH@noaa.gov

Sci Jinks

<http://scijinks.jpl.nasa.gov/>

This site provides NOAA and NASA educational materials and resources related to satellites and weather.

Answer Key

Page 12

S G W N C D V G H Z M H G A R
W A I E O M E G U J G L I P O
W A T Y R O C H R F A C T C A
K I L E R D Z U R L I N D A T
B F L G L C N V I A N F D E U
G S E M U L J A C N Y B K T V
L S U G A R I U A I L I W R N
D D I D T J X T N B I I P O X
H U N T E R S B E E M P P P B
F B S K P W K Z S S E F I I W
M E T E O R O L O G I S T C D
A N I R T A K Z Y Y U T X A A
A C O K A Z Y J D T M O A L B
O Y C Y C L O N E Z M R D G K
N Y G N I N R A W Q I M Z I B

Page 13

Top: Answers are optional

Bottom: 1. Geostationary Operational Environmental Satellites;
Polar-orbiting Operational Environmental Satellites; 2.
Seas; Skies; 3. GOES; 4. POES; 5. Satellites

Page 14

Across: 2. Planet; 5. Order; 6. Floods; 7. Rain 8. NOAA;
11. Evacuate; 14. Doughnut; 15. Eye; 21. Environment; 22. Cyclone;
23. System; 24. Author; 25. Radio; 26. Ready; 28. Agency; **Down:** 1. Im-
ages; 3. Airplane; 4. Meteorologist; 6. Forecast; 9. Tornado; 10. Australian;
12. Tropical; 13. Typhoon; 16. Preparedness; 17. Kits; 18. Geostationary;
19. Scientists; 20. Weather; 27. Watch

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(Top to bottom)

Evacuate, Category, Hurricane, Tornadoes, Tropical,
Moisture, Weather, Satellite, Cyclones, Rainfall

Page 16

14

Page 17

1. Days, 2. Hunters, 3. Form, 4. Season, 5. Flooding,
6. Warning, 7. Watch, 8. Radio, 9. Inland, 10. Eye

Page 18

1. F, 2. T, 3. T, 4. F, 5. T, 6. F, 7. T, 8. T, 9. T, 10. F

Page 19

Suggestions: Share, Rain, Hair, Car, Care, Run, Hurries

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P, C, I, O, A, T, R, L

Answer at bottom: Tropical



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